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THE GENUS *STIZOIDES* (HYMENOPTERA: SPHECIDAE: STIZINI) IN NORTH AMERICA, WITH NOTES ON THE OLD WORLD FAUNA

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No. 7 — *The Genus Stizoides (Hymenoptera: Sphecidae: Stizini) in North America, with Notes on the Old World Fauna*

By James E. Gillaspy[1]

INTRODUCTION

The new species described here increases the New World fauna of *Stizoides* to two, both from North America. In the Old World, on the other hand, twenty-five species names have current status, and the genus is widespread there over the warmer regions, with the exception of east Asia. The figure quoted may not accurately reflect the Old World fauna, however, as the taxon has not been comprehensively revised since the time of Handlirsch's monograph in 1892, and some of the species, which have been differentiated largely on the basis of color, will likely prove to be not above subspecific rank. The species of *Stizoides* are predominantly of dark coloration, including the wings, contrasting with the abundant yellows and whites of many other Stizini and related groups. Three species, *niger* (Radoszkowsky), *verhoeffi* Bytinski-Salz, and *foxi* Gillaspy, new species, are almost totally black, and likewise, apparently, occasional specimens of *klugi* (Smith). At least seventeen species are entirely black and red, according to Lohrmann (1943: 205). The remainder have more or less yellow, two African species, *persimilis* (Turner) and *ctenopus* (Arnold), having abdominal bands of this color on tergites after the first or second, increasing in width on the posterior tergites. *Citrinus* (Klug) of Egypt is almost entirely yellow. Carpenter (1920: 294) apparently attributed an apatetic or aposematic significance to red and black coloration of the type prevalent in this genus, terming it "lycoid." A number of structural features of *Stizoides* are of particular interest beyond the confines of the genus, especially with reference to the Bembicini, for example the single apical spur of the middle tibia of some species and characters of the seventh and succeeding abdominal segments of the male. At least two species appear to have the behavioral trait of cleptoparasitism, laying their eggs on prey of other wasps.

[1]This investigation was in large part accomplished under a National Science Foundation grant (NSF-G17497) for study of the evolution of structure and behavior of nyssonine digger wasps.

In the New World there has long been only a single species known that was assignable to *Stizoides,* the North American form described as *Stizus unicinctus* by Say in 1823. However, W. J. Fox in 1894 listed a "*unicinctus*" from Lower California with the notation: "This is the first specimen of this species seen by me that has the abdomen entirely black." Fox's specimen was presumably destroyed with collections of the California Academy of Sciences in the San Francisco earthquake and fire of 1906, but its lack of abdominal maculation, along with the availability now of additional specimens so characterized, including one from the same area, make plain this was the first recorded example of our second North American species of *Stizoides.* This species, in contrast to the rather widespread *unicinctus,* has a narrow range in the southwestern part of the North American continent, with records at present only from the southern part of the Baja Californian peninsula and from southeastern Arizona.

The limits of the taxon here regarded as constituting a genus, *Stizoides,* appear well defined. Parker (1929: 11) noted the edentate mandibles as unique in the tribe Stizini, and Lohrmann and Beaumont also cite this character, which apparently applies to all *Stizoides.* In addition to this, various partially diagnostic characters are present. Among these are: the strong convergence of the compound eyes toward the clypeus; the presence of an epimeral area; the two sub-parallel free terminal veins at the apex of the hind wing median cell, the latter extending well past the origin of the cubital vein; the flat posterior face of the propodeum; the lateral spiracle-bearing lobes of the seventh tergite of the male; and the pattern of apodemes of the seventh sternite of the male. Within the genus, however, relationships of the species remain in many cases obscure, with principal dependence upon color characters of uncertain value and upon distribution for separation of the species. Vachal and others have contributed a few structural characters of considerable interest, but these have not been broadly applied, and do not provide a conspectus of the species. The generic description presented below has been prepared as a summary of the features in common of the two New World species, and will not apply in some particulars to those of the Old World. Certain relationships of the two faunas are considered in the discussion following the diagnosis.

A number of institutions and individuals have loaned or provided access to specimens used in this study, or have assisted by responding to query concerning presence of *unicinctus* in their collections. In the following list symbols are provided where they will serve to facilitate subsequent reference: AMNH, American Museum of Natural History, New York; ANSP, Academy of Natural Sciences, Philadelphia; CAES, Connecticut Agricultural Experiment Station, New Haven; CAS, California Academy of Sciences, San Francisco; CIS, California Insect Survey, Berkeley; CU, Cornell University, Ithaca, N. Y.; FSDA, Florida State Department of Agriculture, Gainesville; INHS, Illinois Natural History Survey, Urbana; ISU, Iowa State University, Ames; IWC, Iowa Wesleyan College, Mt. Pleasant; JEG, James E. Gillaspy; MCZ, Museum of Comparative Zoology, Cambridge, Mass.; NCDA, North Carolina Department of Agriculture, Raleigh; NCSC, North Carolina State College, Raleigh; National Museum, Paris, France; OHSU, Ohio State University, Columbus; RRD, R. R. Dreisbach, Midland, Mich.; TAMC, Agricultural and Mechanical College of Texas, College Station; UARIZ, University of Arizona, Tucson; UARK, University of Arkansas, Fayetteville; UCD, University of California, Davis; UG, University of Georgia, Athens; UIDA, University of Idaho, Moscow; UMICH, University of Michigan, Ann Arbor; UMINN, University of Minnesota, St. Paul; UNEV, University of Nevada, Reno; USNM, U. S. National Museum, Washington, D. C.; and Universitetets Zoologiske Museum, Copenhagen, Denmark.

SYSTEMATIC DESCRIPTION

Genus STIZOIDES Guerin

Stizus: subg. *Stizoides* Guerin, 1844, Iconogr. Regn. Anim. 3 (text): 438 [type: *Larra fasciata* Fabricius, 1798 (designated by Parker, 1929: 10) = *Stizoides assimilis* (Fabricius)].

Larra: Smith, 1856, Cat. Hym. Brit. Mus. 4: 337 (part).

Stizus: Patton, 1879, Bull. U. S. Geol. Surv. 5: 346; Cresson, 1887, Trans. Amer. Ent. Soc., Supp.: 115, 278 (part); Fox 1895, Proc. Acad. Nat. Sci. Phila.: 266 (part); Kohl, 1896, Ann. k. k. Naturhist. Hofmus., Wien 11: 421-424 (part); Dalla Torre, 1897, Cat. Hym. 8: 519-534 (part); Bingham, 1897, Fauna Brit. India Hym. 1: 276-277 (part); Mickel, 1918 (1917): 432-435 (part).

Stizus: (*tridentatus* group) Handlirsch, 1892: 97; Berland, 1925, Faune de France 10: 78; Arnold, 1929: 314; Arnold, 1944: 77; Mochi, 1939: 187.

Stizoides: Ashmead, 1899, Can. Ent. 31: 346; Parker, 1929: 10; Pate, 1937, Mem. Amer. Ent. Soc. No. 9: 61; Lohrmann, 1943, Mitt. Münchn. Ent. Ges. 33: 189, 205; Krombein, 1951: 994; Beaumont, 1954: 313; Bytinski-Salz, 1955: 51-52; Van der Vecht, 1961, Zool. Verhandel. No. 48: 53.

Stizolarra Saussure, 1887, Soc. Entom. 2: 9 (part).

Omphalius Vachal, 1899 (not Philippi, 1847, not Erichson, 1891): 534-535 [type: *Omphalius niger* Vachal (monotypic) = *Stizoides niger* (Radoszkowsky) (new synonymy)]; Pate, 1937, Mem. Amer. Ent. Soc. No. 9: 61.

Scotomphales Vachal, 1900, Bull. Soc. Ent. France: 233 (new name for *Omphalius* Vachal); Pate, 1937, Mem. Amer. Ent. Soc. No. 9: 57; Beaumont, 1954: 313 (new synonymy).

Stizus: subg. *Tachystizus* Minkiewicz, 1934, Polski Pismo Ent. 12: 251 [type: *Crabro tridentatus* Fabricius (designated by Pate, 1937, Mem. Amer. Ent. Soc. No. 9: 63)].

Female. — Size medium, between that of *Bembecinus* and *Stizus,* form slender, appearing cylindrical, head, thorax, and abdomen being of about equal width. *Color* largely black, including wings, latter with bluish or violaceous reflection; distal segments of tarsi, margins of some abdominal segments, and, in *unicinctus*, anterior two-thirds of tergite 2, reddish, this distributed through the integument and thus differing from the yellows and whites of other genera, which underlie the clear, sclerotized integument; wing 1 clear at apex beyond closed cells, or including apex of marginal cell, also clear in costal cell with extension into 1st submarginal cell past end of subcosta, latter appearing completely interrupted before stigma; wing 2 without marginal clear areas. *Vestiture* inconspicuous, largely of simple erect or recumbent black or brownish hairs, specialized silvery-appressed hairs not present. *Sculpture* consisting of punctures and micro-reticulation, punctures coarser than in allied genera, particularly strong on thorax, where they are round, deep, and dense, often separated by less than their own diameter. *Head* one and one-third wider than its length from vertex to anterior margin of clypeus, slightly wider than thorax measured at prothoracic lobes; vertex on level of upper extremity of compound eyes, except between lateral ocelli, where it is distinctly higher; compound eyes in front faintly emarginated

before anterior ocellus, distinctly converging toward clypeus; maxillary and labial palpi with 6 and 4 segments, respectively; maxillae short, length beyond base of palpi less than one-third of vertical length of compound eyes; mandibles edentate; labrum slightly wider than long, semicircular in outline; clypeus small, very weakly arched in lateral profile, broadly biconcave in frontal outline through basal emargination along frontoclypeal suture between tentoria, opposed by apical emargination; tentorial pit a foramenlike opening at bottom of tentorial fovea, marking nearest approach of clypeus to subantennal line, from which it is separated by about intersocketal distance; scape about 2 X longer than its greatest width; intersocketal carina present, with low point at middle of antennal sockets dividing sharply carinate upper portion from very broad and rounded lower part; antennae slightly clavate; lateral ocelli with outer side slightly less rounded, circumocellar sulcus on this side with short appendiculate sulcus extending somewhat obliquely inward across vertex; all ocelli with lens modified to some extent by an impressed line or unevenness on surface inward with respect to ocellar triangle; anterior ocellus in shallow depression formed by strongly mounded surface before it, and lower mounds between it and lateral ocelli. *Thorax* with notaulices not evident exteriorly (dissection reveals curved phragmata internally); dorso-lateral metanotal area strongly flangelike posteriorly, forming the dorsolateral metanotal scale which extends caudad over a well-defined prespiracular pit at the base of the propodeum and also overlies and conceals a considerable segment of the narrowly rimlike connecting bridge between the median mesonotum and the metapleuron; propodeum rounded postero-laterally, flattened behind, sides of propodeal triangle in basal area converging at an angle of about 70 degrees toward apex on posterior face of propodeum, apex being between thin vertical carinae extending upward from submarginal sulcus. *Legs* with pecten of tarsus 1 comprised of 11-12 main bristles distributed over segments 1-4, distal lobe of each segment furnished with 2, basitarsus with 3-4 before the lobe; pretarsal structures moderately developed, arolium outwardly extending approximately as far as outer limit of basal third of claws; middle tibiae with two apical spurs, inner one slightly shorter. *Fore wings* with stigma small, not as wide as costal cell; marginal cell slightly receding from anterior wing margin at its outer end, shorter than 1st submarginal but latter less than 1½ X as long; second submarginal cell narrowed above but not

petiolate, although 1st and 2nd recurrents may join radial at same place. *Hind wings* without bullae; free abscissa of radius and cubitus extending beyond transverse cubital vein and these almost parallel with each other; cubital vein joining median vein at distance before end of submedian cell greater than width of that cell. *Abdomen* without an area of specialized micropunctation on sternite 2.

Male. — Similar in appearance to female, but size appears to average slightly smaller. Flagellar segments 4-11 excised distally on side inward to curvature of antennae, increasing in degree on more distal segments. Abdominal sternite 2 without carina, process, or specialized punctation; tergite 7 glabrous across entire base, lateral lobes broad, separated medially by less than width of either; sternite 7 extending to apex of tergite 7, median apodeme traversing most of its length; sternite 8 trifurcate, without ventral spine. Genitalic cuspis shorter than digitus.

Discussion. — The North American *unicinctus* and *foxi* appear more closely related to *tridentatus* (Fabricius) than to the other Old World species I have seen and on the basis of information available from descriptions, five other species at least may also belong here, forming a category to which *Tachystizus* Minkiewicz is applicable. The two North American species lack the silvery facial pubescence and distinctly shortened inner calcar of tibia 2 of *tridentatus* and differ from it also in length ratios of the three basal flagellar segments, the pattern of banding of the abdomen, and the male genitalia, but an overall affinity seems apparent. The remaining Old World species I have seen are: *assimilis* (Fabricius) (1 ♀, Deesa, India, USNM; 1 ♂, east India, kindly sent as an exchange from the Universitetets Zoologiske Museum, Copenhagen, Denmark), *fenestratus* (Smith) (2 ♂ 1 ♀, Boma, Congo, 13° 0′ E, 6° 0′ S, 17-19.VI.15; 3 ♀, Thysville, Congo, 15° 0′ E, 5° 30′ S, 21.VI.15, all Lang and Chapin, AMNH), and *niger* (Radoszkowsky) (1 ♂, Olokemeji, Ibadan, Nigeria, USNM; 1 ♂, Faradje, 29° 40′ E, 30° 40′ N, —.IX.12, Lang and Chapin, USNM). These have in common a micropunctate, velutinous area, medially placed at the base of sternite 2 and present in both sexes. This is mentioned by Vachal (1899) as a character of his new genus *Scotomphales*, and it is also apparently present in *cyanipennis* (Saussure) and *poecilopterus* (Handlirsch), as revealed by descriptions. At least five species are thus differentiated from the remainder of *Stizoides*, cleaving the genus into two major subgroups.

Beaumont (1954: 313) advanced the question of the proper disposal of *Scotomphales*. Through the courtesy of the Paris Museum I was able to examine the male specimen upon which this genus was based and find it is the same as the now relatively well known *Stizoides niger* (Radoszkowsky), which was based upon a female specimen. Vachal applied the specific name *niger* to his species and regarded it as likely the same as the *niger* of Radoszkowsky. It is now plain that the species is widespread in equatorial Africa, Vachal's specimen being from Bata, Spanish Guinea, and that of Radoszkowsky from Angola, while, besides the specimens I have seen from Nigeria and the Congo, Turner (1912) and Arnold (1929) list it from Uganda and Angola. The primary character cited by Vachal for *Scotomphales* is the presence of only one apical spur of the middle tibia. This is a tribal character of the closely related Bembicini, but presumably of independent origin in *Stizoides*. Two of the species available to me, *niger* and *fenestratus*, have the inner calcar absent; one, *tridentatus*, has it strongly reduced in size; while three, *assimilis*, *unicinctus*, and *foxi*, have it normal, only slightly shorter than the outer calcar. Another distinction mentioned by Vachal concerns sternite 8, which he described as unispinose. My dissection of the type specimen reveals the central spine to be unusually long but lateral spines to be present although slender, very like the condition in *assimilis* and *fenestratus* and differing, along with them, from the other *Stizoides* I have seen.

Three nominate categories are validated by structural characters and available for the species falling under the genus *Stizoides*. These are treated here as subgenera, with assignment of species as follows where it has been possible to examine specimens, or where descriptions have included the pertinent characters:

No specialized area of sternite 2; tibia 2 with two apical calcaria

Tachystizus

crassicornis (Fabricius)
foxi new species
funebris (Handlirsch)
klugi (Smith)
melanopterus (Dahlbom)
tridentatus (Fabricius)
unicinctus (Say)
verhoeffi Bytinski-Salz

Specialized area of sternite 2 present
Tibia 2 with two apical calcaria
Stizoides sensu stricto
assimilis (Fabricius)
**cyanipennis* (Saussure)
**poecilopterus* (Handlirsch)
Tibia 2 with one apical calcar
Scotomphales
fenestratus (Smith)
niger (Radoszkowsky)

The following species are unassigned, but all or most may belong under *Tachystizus: abdominalis* Dahlbom; *amoenus* (Smith); *blandinus* (Smith); *citrinus* (Klug); *conscriptus* (Nurse); *cornutus* (Smith); *ctenopus* (Arnold); *cyanopterus* (Gussakovskij); *egregius* (Gussakovskij); *erythrogaster* (Turner); *mionii* Guerin; *persimilis* (Turner); *simpsoni* (Turner); and *stenopus* (Arnold).

Key to North American Species of *Stizoides*

1. Antennae 13-segmented, abdomen 7-segmented (males) 2
   Antennae 12-segmented, abdomen 6-segmented (females) 3
2. Abdominal tergite 2 black; sternite 6 transversely swollen at base; last segment of antennae strongly curved and tapering ..... *foxi* n. sp.
   Abdominal tergite 2 reddish in anterior two-thirds; sternite 6 normal; last segment of antennae less strongly curved and the apex truncate ..... *unicinctus*
3. Abdominal tergite 2 black; femur 3 stout, less than 4 X longer than greatest width; abdominal punctation strongly developed, particularly evident on sternites ..... *foxi* n. sp.
   Abdominal tergite 2 reddish in anterior two-thirds; femur 3 more slender, more than 4 X longer than greatest width; abdominal punctation, particularly of sternites, in large part sparse, weakly defined ..... *unicinctus*

Stizoides (Tachystizus) foxi new species
(Figs. 1, 2, 5, 7, 9, 11)

Stizus unicinctus: Fox 1894: 104.

Holotype.— ♀, ARIZONA: Madera Cyn., Santa Rita Mts., 31.VIII.58 (R. M. Bohart) [MCZ No. 30490].

*I have not seen specimens of these and the tibial calcaria are not specifically mentioned in species descriptions, but are probably normal (two).

Description of type female. — Length 13 mm. Color black except tarsi more or less reddish, margins of abdominal segments faintly so, and apex of fore wings beyond closed cells (but with slight extension into apex of marginal cell) clear. Sculpturing generally stronger than that of *unicinctus,* punctures deeper, of more sharply defined round shape, more often dense to an extent that space between punctures is less than their diameter, best compared on abdominal tergite 2 laterally, sternite 2, and pygidium. Ratio of least interocular distance at clypeus to greatest facial interocular distance at vertex 1.00:1.71:1.45. Single curved, flangelike median carina traversing upper epimeral area. First three segments of flagellum 62:36:34. POL/OOL = 1.75. Legs stouter than in *unicinctus,* 3rd femur 3.7 X longer than greatest width, which is almost median. Abdomen with sternite 2 most densely and finely punctate medially near base, sparsely punctate along median apical margin, but without sharp gradation in density or size of punctures.

Allotype. — ♂, same data as the holotype [MCZ No. 30490].

Description of allotype male. — Length 15 mm. As in the female, abdominal maculation lacking. Abdominal sternite 6 with a rounded transverse ridge extending the width of the segment at base, and apical margin of sternite 5 shallowly emarginated in accordance with contour of the ridge.

Paratypes. — ARIZONA: Cochise Co., Apache, 1 ♂, 13.VIII.44 (W. W. Jones, CIS); Apache, 3-5 mi. SW, 4300′, on *Baccharis glutinosa,* 1 ♀, 1 ♂, 8.VIII.59 (H. E. Evans, CU); Cochise, fls. *Lepidium,* 1 ♂, 21.VII.61 (J. E. Gillaspy, JEG); Dos Cabezos, ♂, 20.VIII.58 (E. G. Linsley, CIS); Pearce, 3 mi. E, fls. *Lepidium,* 2 ♀, 7 ♂, 21.VII.61 (J. E. Gillaspy, JEG); Willcox, 2.5 mi. S, ♀, 17.VIII.56 (E. Ordway, AMNH). Pima Co., Continental, on fls. *Kallstroemia,* 3 ♀, 2-4.VIII.59 (K. V. Krombein, USNM). Santa Cruz Co., 3 ♀, 2 ♂, same data as types (UCD); Patagonia, 10 mi. SW, on *Croton,* 4 ♂, 13.IX.58 (P. D. Hurd, CIS). BAJA CALIFORNIA: San Pedro, 1 ♂, 7.X.41 (Ross and Bohart, CAS).

Recorded distribution. — BAJA CALIFORNIA: San Jose del Cabo, October (Fox, 1894: 104).

Discussion. — The observed range in length of females is 10-16 mm., of males 13-17 mm. Indistinct red may occur on the pygidium and other abdominal sclerites, and one specimen has narrow preapical bands of this nature on tergites 3-4. There may in some cases be two carinae of the upper epimeral area, rather than one.

Stizoides (Tachystizus) unicinctus (Say)
(Figs. 3, 4, 6, 8, 10, 12)

Stizus renicinctus Say, 1823, West. Quart. Reporter 2: 77 [type: ♂ "Inhabits Arkansa" (presumably destroyed)].

Stizus unicinctus Say, 1824, Amer. Ent. 1: 4, pl. 2, figs. 3-4, ♂ (emend.); Leconte, 1859, Writ. of Th. Say Ent. 1: 4, pl. 2, figs. 33-34; Cresson, 1863, Proc. Ent. Soc. Phila.: 268; Patton, 1879, Bull. U. S. Geol. Surv. 5: 346, 361; Cresson, 1887, Trans. Amer. Ent. Soc., Supp.: 278; Handlirsch, 1892: 103; Fox (not Say), 1894: 104; Fox, 1895, Proc. Acad. Nat. Sci. Phila.: 268; Dalla Torre, 1897, Cat. Hym. 8: 533; Johnson and Rohwer, 1908, Ent. News 19: 374; Smith, 1908, Neb. Univ. Stud. 8: 12; Williams, 1913: 230; Mickel, 1918 (1917): 435; Rau and Rau, 1918: 180-193; Wheeler, 1919: 15, 19, 22; Carter, 1925: 133; Brimley, 1938: 448; Rau, 1938: 543; Nielsen, 1945, Spolia Zool. Mus. Hauniensis 7: 141; Rau, 1946: 2.

Larra unicincta: Cresson, 1865, Proc. Ent. Soc. Phila. 4: 472; Packard, 1867, Proc. Ent. Soc. Phila. 6: 444; Packard, 1870, Guide Study Ins.: 164; Cresson, 1872, Trans. Amer. Ent. Soc. 4: 223.

Stizoides unicinctus: Ashmead, 1899, Can. Ent. 31: 347: Lohrmann, 1943: 206; Krombein, 1951: 994; Krombein, 1958: 195; Arens and Arens, 1953: 191-192; Evans, 1955: 299.

Megastizus unicinctus: Smith, 1915: 10-11.

Description of female. — Color black except clear areas of wings, reddish basal band of tergite 2, and usually more or less reddish on antennae, mandibles, pygidium, and sometimes elsewhere on abdomen. Sculpturing of thorax strongly developed, punctures dense, deep, and round, but abdominal punctures mostly shallow, widely spaced, not round in shape. Inner margins of compound eyes converging more strongly toward clypeus than in *foxi*, ratio of least interocular distance at clypeus to greatest facial interocular distance (this is between antennal sockets and anterior ocellus) and to least interocular distance at vertex 1.00:1.83:1.65. Antennal segments 3:4:5 = 60:38:36. POL/OOL = 1.85. Upper epimeral area traversed medially by two curved, lamellate carinae which diverge anteriorly. Legs slender, 3rd femur 4.0 X longer than greatest width, which is before middle of segment. Abdomen with sternite 2 sparsely punctate, particularly in median basal area, and the punctures uneven in size and shape.

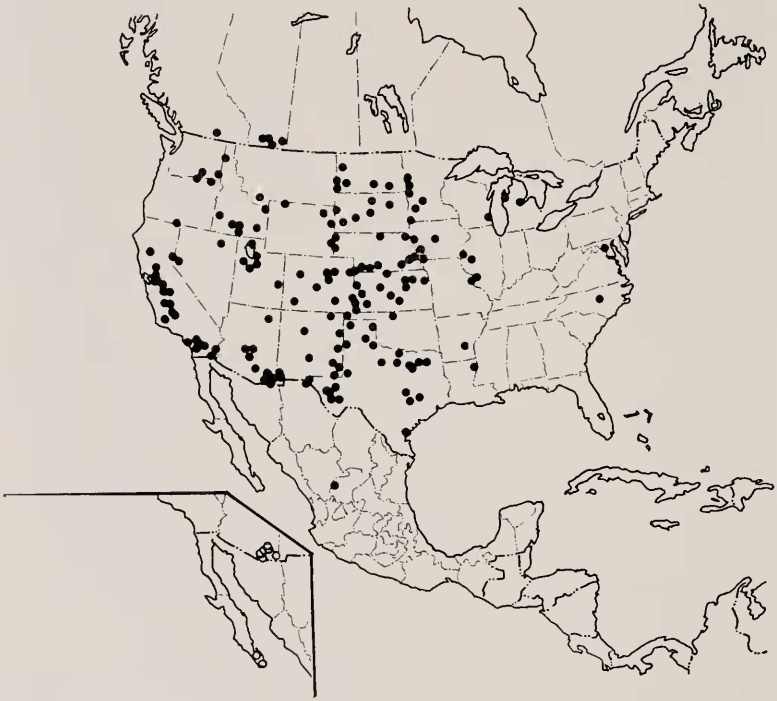
Male. — Similar to female. Abdomen with sternite 6 unmodified.

Discussion. — The ratios above are from a Scott, Kansas, specimen. The range in length of the specimens I have seen is 12-20 mm. for the female and 9-17 mm. for the male. It is possible the specimens from at least some areas in the south are of larger average size, but little important variation otherwise is seen over the rather extensive range. The abdominal maculation is relatively constant in shade, always with considerable reddish element.

Distribution. — The accompanying map summarizes distributional data taken from more than five hundred specimens of *unicinctus* examined in this study and also from published records, as well as in certain cases from persons who have specimens in their keeping or possession. The species is apparently well represented in southern Canada, and in addition to three Alberta localities reported by Carter, I have seen four specimens from Medicine Hat, Alberta, 8-13.VIII.39 (R. H. Strickland, ANSP) and three specimens from Vernon, British Columbia, 5.IX.45 (H. B. Leech, USNM). A female from 15 kilometers east of Sombrerete, Zacatecas, Mexico, collected 28-31.VII.51 (H. E. Evans, MCZ) indicates a considerable southward range, although the only other Mexican record is from the northern border of the country.

In the United States, *unicinctus* is apparently quite uncommon east of the Mississippi River. Along the Mississippi, I have seen specimens from: Carlinville, Illinois, twenty-four specimens (11 ♂ 13 ♀) taken between the years 1887 and 1902 (INHS); and Carman, Illinois, Quiver Lake, one specimen, 3.VII.37 (C. O. Mohr and B. D. Burks, INHS); and the Raus (1918) report the species at St. Louis. I have also seen two females from Tallulah, Louisiana, 24.VII.25 (UMICH, UMINN). Eastward of the Mississippi, the New York and New Jersey catalogs do not record it, and collections surveyed, as listed elsewhere, divulged only the specimens listed below. R. R. Dreisbach of Midland, Michigan, has kindly supplied me with records of a Michigan specimen from each of two localities, Midland Co., 23.VIII.38 and Benzie Co., 29.VII.40, and I have seen one male from "Mich." (USNM). I have seen specimens from Havana, Illinois, year 1894, on *Ceanothus*, at night (INHS); a male from Milwaukee, Wisconsin, 28.VII.04 (S. Graenicher, MCZ); a female from Washington, D. C. (Chittenden, USNM); and a male from "North Carolina"

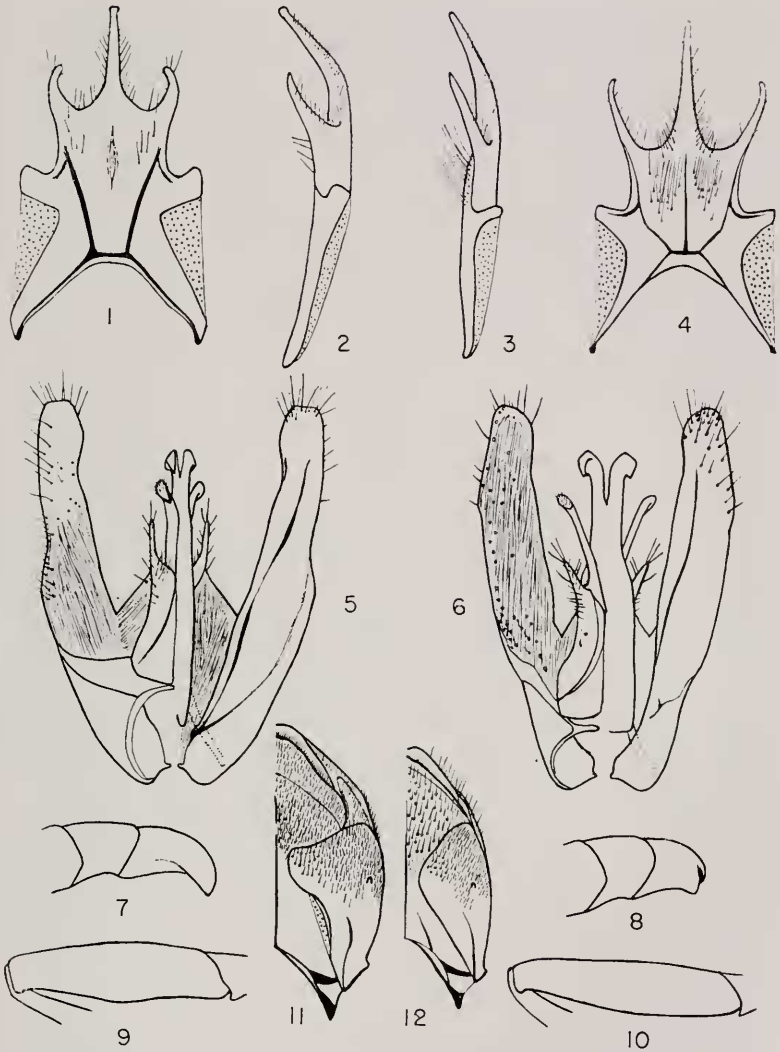
(T. Pergande Collection, USNM). Brimley (1938: 448) recorded the species from Raleigh, North Carolina, and the specimen is reported to be still in existence, having been collected 19.IX.00 (Franklin Sherman, NCDA). Thus, despite the considerable number of collections surveyed, I have seen or have records of only nine specimens from east of the Mississippi, and all except two Michigan records are quite old.



Map showing distributional records of North American *Stizoides. Unicinctus* (Say) indicated by solid dots on the larger map, *foxi* n. sp. by hollow circles on the insert map.

BIOLOGY OF *STIZOIDES*

The life history of *Stizoides* was first reported upon by Williams (1913: 230), and his observations on the North American *unicinctus* revealed a mode of life considerably at variance with that of other stizines and bembicines. He found this species in



Stizoides foxi n. sp. Fig. 1, sternite 8, male, ventral; Fig. 2, same, lateral; Fig. 5, male genitalia; Fig. 7, terminal segments of antenna, male; Fig. 9, femur 3, lateral, female; Fig. 11, segment 7, male, ventral. *Stizoides unicinctus* (Say). Fig. 3, sternite 8, male, ventral; Fig. 4, same, lateral; Fig. 6, male genitalia; Fig. 8, terminal segments of antenna, male; Fig. 10, femur 3, lateral, female; Fig. 12, segment 7, male, ventral.

a cleptoparasitic role, laying its egg on the stored grasshopper prey of a sphecine wasp. Cleptoparasitism is known to occur in various aculeates, including *Nysson* and some Pompilidae, but not in groups closer to *Stizoides*. Williams' brief observations encompassed the major points known to now about *Stizoides* life history, although later workers have provided support for his findings and enlarged upon them to some extent. European observers (Arens and Arens, 1953) found the Old World *tridentatus* behaving similarly, and it seems possible this pattern of life occurs throughout the genus, although the observed species represent a rather small segment of the structural diversity present.

Unicinctus is readily distinguished from its near relatives in North America through being almost entirely of an intense black color except for a reddish abdominal band. It is perhaps less abundant in collections than would be expected, being apparently recognized as common and not taken by many "sophisticated" collectors. Its habitus, which may be apatetic or aposematic, is one often found in spider wasps, larrids, and scoliids, but not in other New World stizines or bembicines. In an attempt to gain some concept of the seasonal pattern of occurrence of this wasp the date records from specimens that were examined in this study were tabulated, arbitrarily dividing the range into northern (Kansas-Nevada, northward) and southern (Oklahoma-California, southward) districts and utilizing semi-monthly (1-15, 16-end) time periods. A number of records available from specimens not seen by me agree in general with the data presented. Despite the conceivable biases that could affect a museum sample, including the varying motivations and commitments of the collectors involved, the results appear to warrant a number of conclusions as to population trends. The general concordance of number of collections with number of specimens and the decline in percentage of males serving as an independent index of the progress of the season, encourage confidence that relative abundance is reflected to a fair degree, although a larger sample could be desired, especially in the southern area. It may be noted here that Bytinski-Salz (1955: 51) found period of occurrence one of the few differences setting apart his new species, *S. verhoeffi*, from the very similar, sympatric *S. klugi*.

From the data presented above, the following seem evident: the approximate main periods of flight (mid-June to mid-September in the north and mid-May to mid-October in the south); the peak of abundance in late July in the north and evidence

NORTHERN AREA

Extreme records: ♀, June 6 — ♀, September 16

	MAY		JUNE		JULY		AUG.		SEPT.		OCT.		NOV.
	1-15	16-31	1-15	16-30	1-15	16-31	1-15	16-31	1-15	16-30	1-15	16-31	1-15 Totals
1			(1)	(11)	(15)	(29)	(15)	(11)	(7)	(5)	(2)		(96)
2			1	12	11	22	9	12	10	4	1		82
3			0	20	22	40	17	11	14	1	1		126
4			1	32	33	62	26	23	24	5	2		208
5			33		95		49		29		2		
6			61%		64%		57%		52%		—		

SOUTHERN AREA

Extreme records: ♂, May 2 — 2 ♀, November 6-8

1	(5)	(9)	(13)	(8)	(5)	(16)	(4)	(7)	(6)	(5)	(8)	(5)	(2)	(93)
2	0	5	4	13	0	7	3	4	5	5	11	7	3	67
3	9	13	12	35	9	26	7	10	3	4	4	0	0	132
4	9	18	16	48	9	33	10	14	8	9	15	7	3	199
5	27		64		42		24		17		22		3	
6	82%		73%		83%		71%		41%		18%		0%	

TOTAL SPECIMENS: 407

1. Number of separate collections in each semi-monthly period.
2. Number of females for each semi-monthly period.
3. Number of males for each semi-monthly period.
4. Total males and females for each semi-monthly period.
5. Monthly total, males and females (semi-monthly totals combined).
6. Percentage of males for each month.

that the peak is probably somewhere between mid-June and the end of July in the south, where the protracted season makes a larger sample particularly desirable; overall accordance with a univoltine annual cycle; protandry; percentagewise and actual reduction of males in August; and longer survival of females at the end of the season, the decline in abundance of males producing a reversal in the ratio of the sexes in September. The peak in late June in the southern area is an effect of large collection size and contra-indicated as a meaningful statistic by the small number of collections, although a June peak of activity in this area remains a possibility.

The observations of Williams, mentioned previously, and others of Smith (1915: 10-11) disclosed *Prionony.x atratus* (Lepeletier) serving as the apparent host of *unicinctus*, while the Raus (1918: 180-193) found both this species and *Prionony.x thomae* (Fabricius) victimized. All noted *unicinctus* frequenting nesting sites of the host species, and the Raus (1918: 191) concluded that stored grasshoppers were located by two methods: "by inspecting all breaks in the surface of the earth where *Prionony.x* nests are likely to occur, in order to locate the nest when closed, and by shadowing the *Prionony.x* while she is storing her prey and closing the hole." There was agreement also that *unicinctus* opens the nest of the host, destroys the egg of the latter on the stored grasshopper, and replaces it with her own. Williams and the Raus presented certain limited observations which support this conclusion. Nielsen (1945: 141) regarded the parasitic relationship as unproven although admitting it to the status of a strongly supported supposition. The observers all noted the parasite entering open burrows and opening closed burrows, and Williams encountered one smoothing over an area which proved to have beneath it a "filled-up" burrow. On the stored grasshopper he found an egg which he took to be that of *unicinctus*, since it was shorter and more cephalad in placement than that of *atratus*, with which he was familiar. Apparent vestiges of the *atratus* egg remained in the usual position, at the base of one of the hind femora of the grasshopper. It is perhaps to be gathered that the burrow was more or less normally closed, somewhat in the fashion of *Prionony.x*, in this case; in contrast, however, *unicinctus*, according to Smith, ". . . is not particular about refilling the burrow, nor does she attempt to hide the location of it in any manner, as does the *Prionony.x*. Oftentimes *Megastizus* [*Stizoides*] *unicinctus* will leave the nest when the

burrow is not more than half refilled with soil. Occasionally the *Priononyx* will be driven from her nest by *Megastizus* while in the act of filling up her burrow." The Raus noted only one *unicinctus* in the act of nest closure: "She came out and kicked in all of the loose dirt, then dug up more with her mandibles, kicked it under her body into place, and picked up and placed a few more bits until the hole was once more nicely covered." In possible contrast to this closed burrow, however, the Raus were mystified at finding a considerable number of open burrows, apparently of *Priononyx*, with the stored grasshoppers ruined by ants and dipterous parasites. They speculated on the possibility that this was the work of *unicinctus*. The closed burrow contained a stored grasshopper: "The egg of *thomae* was in its usual position on the right femur, at the base of the abdomen, but lo! it was only an empty sac! Evidently *Stizus* [*Stizoides*] *unicinctus* had mutilated the egg by malaxation, or had sucked the contents for food. We found no *Stizus* egg; but it is probable that, in the difficulty of opening the nest in a harsh cinder bed, it was knocked off by crumbling walls."

No other published information bearing on the relationship of *unicinctus* to its insect hosts is known to me, but Rau (1946: 2) noted it visiting flowers of *Pycnanthemum flexuosum* (Libiatae), the Raus (1918: 190) on white snakeroot, *Eupatorium urticaefolium* (Compositae) and Rau (1938: 543) observed a sleeping aggregation: "Six of these wasps were found July 20, 1919, asleep, close together, on one head of teasel-grass at the edge of a field of wheat stubble." Mickel [1918 (1917): 117] adds *Melilotus alba* (Leguminosae), *Achillea millefolium* (Umbelliferae) and *Asclepias* sp. (Asclepiadaceae) to the list of flowers visited. I have found the following flower records, listed here under their families, on labels of specimens examined in this study: Asclepiadaceae (*Asclepias latifolia, A. subverticillata, A. verticillata*); Capparidaceae (*Wislizenia refracta*); Caprifoliaceae (*Symphoricarpos occidentalis*); Chenopodiaceae (*Salsola kali*); Compositae (*Baccharis salicina, Baileya pleniradiata, Haplopappus hartwegi, Kuhnia oligophylla, Lepidospartum squamatum, Solidago* sp.); Convolvulaceae (*Cuscuta arvensis*); Crueiferae (*Stanleya primata*); Euphorbiaceae (*Croton californica, Euphorbia marginata*); Leguminosae (*Acacia greggii, Lepidium montanum, Medicago sativa, Prosopis juliflora*); Polygonaceae (*Polygonum* sp.); Tamaricaceae (*Tamarix gallica*); Umbelliferae (*Polytaenia nuttallii*); Verbenaceae (*Phyla incisa*).

In southern Idaho in 1955 I observed sleeping aggregations of *unicinctus* on two occasions. In the early morning of August 10, on the floor of a valley-like crater some hundreds of feet long in Jerome County, about nine miles south of Shoshone, an aggregation of *unicinctus* (2 ♀ ♀, 4 ♂ ♂) and *Prionyx* (*Prononyx*) *atratus* (Lepeletier) (2) [1 ♂ det. A. Menke] was found on a live tumble mustard (*Sisymbrium altissimum*) plant. The wasps were in a loose gathering with no individuals in physical contact. More specialized, perhaps, are dense, ball-like clusters of *Stictiella pulla* (Handlirsch), *Steniolia elegans* Parker, and *Steniolia scolopacea albicantia* Parker, observed during the same season, and the cluster of *Zyzzyx chilensis* (Eschscholz) pictured by Claude-Joseph (1929: 419). At a locality 10 miles north of Owinza, Lincoln County, on August 15, another such aggregation was observed. In this instance eight *unicinctus* and three *atratus* were atop a plant belonging to the goosefoot family (Chenopodiaceae), at a height of ½ meter, at 1900 hours, in the shade. Nearby, in a sunny area, *Steniolia elegans* females were still actively hunting. Again the aggregation was loosely formed, with no individuals in actual contact in a cluster. This side-by-side sleeping contrasts with behavior in the vicinity of the burrow, where there may be decided aggressive action on the part of the host toward the parasite, with incidence of fierce pursuits and physical tussles. The Raus report this type of behavior, and also the Arens (Arens and Arens, 1953), although in the case of the latter authors the European *Stizoides tridentatus* was involved. Williams, on the other hand, noted a case in which an *atratus* abandoned her prey when she returned and encountered a *unicinctus* occupying her burrow.

In the Old World the Arens (*loc. cit.*) in European Russia (Lake Serebryanka-Udelnaya, Khopersky Reserve, Voronezh region and along the sandy banks of the Khopro River, opposite the Kalinova cordon) found *Stizoides tridentatus* and *Sphex maxillosus* (Fabricius) displaying numerous evidences of a parasite-host relationship, although, as in the case of *unicinctus*, such formal proof as a reared parasite, or other relatively indisputable evidence, was not secured. Four colonies of the *Sphex* were reported, each with female *Stizoides* present. The latter were "for hours" in low searching flight over the *Sphex* colonies. They tended to remain in the vicinity of the burrows and, in the absence of the host, entered them for sometimes extended periods. Upon leaving they spattered the burrow with soil in a superficial

"closure," regarded by the Arens as a behavioral vestige from free-living ancestors. Returning *Sphex* unceremoniously ejected *Stizoides* that were in their burrows if the latter did not succeed in darting forth themselves, and *Sphex* were also seen to harass the parasites in the air outside the nests. The observed nectar host of the *tridentatus* in the vicinity was *Eryngium intermedium* (Umbelliferae).

Only one other observation from the Old World is known to me and is of doubtful pertinence, since the wasp concerned was not definitely identified as a *Stizoides*, but would be of unusual interest if confirmed. Carpenter (1920: 293-294), writing about observations made in 1912 on an island in Lake Victoria, British East Africa, mentioned a wasp that appeared in a colony of *Bembix ugandensis* Turner. He described it as "a medium sized fossor of quite a different type, with the black and orange 'lycoid' colouring." It remained for some time in and near the *Bembix* burrows, as noted for *Stizoides* in the *Prionony x* and *Sphex* colonies. A returning *Bembix* abandoned her prey in a manner reminiscent of Williams' *P. atratus* when she encountered the intruder in her nest, but finally entered the nest on a third return trip despite the presence of the other wasp within. No conflict was apparent, the intruder coming out after a few seconds and then re-entering while the *Bembix* was still inside. Victimization of the Diptera-predatory, progressive-provisioning *Bembix* would appear to constitute a considerable behavioral departure for *Stizoides* on the basis of other observations of the genus, since the sphecines prey on Orthoptera and practice mass provisioning. Evans (1955: 299) has noted that cleptoparasites are characteristically associated with forms to which they are closely related, as shown by Wheeler (1919). The closest relatives of *Stizoides* are in the genus *Stizus*, whereas the sphecines are relatively distant phyletically; however, *Stizus* and the sphecines have in common the use of Orthoptera as prey, and Evans says: "Undoubtedly *Stizoides* arose as a cleptoparasite of *Stizus* (judging from many similar cases in the wasps and bees), and *unicinctus*, at least, underwent sufficient modification of its behavior patterns to enable it to attack another, much more common hunter of Orthoptera, *Prionony x*."

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